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DATA PROCESSING AND CANADIAN APPRENTICESHIP ADMINISTRATIONS

by

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A THESIS

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR

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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Data Processing and Canadian Apprenticeship Administrations submitted by Myron Murray Marche in partial fulfilment of the requirements for the degree of Master of Education in Vocational and Industrial Education.

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ABSTRACT

This study reviewed the use of electronic data processing (EDP) by Canadian apprenticeship administrations, with a view to establishing a rational basis for deciding the direction, nature, and extent of a commitment to EDP by the Apprenticeship and Trades Certification Branch of Alberta, and similar organizations who consider using this technology.

The use of computing by the apprenticeship organizations of British Columbia, Ontario and Quebec was studied by a team of three researchers using interview technique. Personnel in each of the organizations from clerks to senior managers were asked to report on their experience during development, implementation and operation of computer systems to support administration.

The study concluded that a move to use EDP was a major change for an organization yet there was no formal effort to manage this change. Such a major change should be attempted during a period of organizational stability if possible.

The systems under study were better described as "clerical information systems" rather than "management information systems". An epistemological model is presented in order to resolve terminology conflicts and to provide a base for more realistic expectations about the potential and limitations of EDP information systems.

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DATA PROCESSING AND CANADIAN APPRENTICESHIP ADMINISTRATIONS

CHAPTER 1

INTRODUCTION

Background

While the concept of apprenticeship stretches back through the guilds of medieval days into antiquity, the origins of what has been termed "modern apprenticeship" are the result of an industrial society. For Alberta specifically, the passage of the Tradesmen's Qualification Act in 1936 signaled the beginning of government involvement in the standards and proficiency of trades people (Department of Labour, Ottawa, 1957, p. 9). Provincial governments provided the vehicle for the subsequent centralization of trade training administration.

In 1944, the Dominion Government offered financial incentives to the provinces which were willing to share apprenticeship costs. The Alberta government in accordance with the Dominion Apprenticeship Agreement, passed The Apprenticeship Act which conformed to the standards established by the senior level of government, and the Act was proclaimed in 1945 (Department of Trade and Industry, Edmonton, 1954, p. 2).

Alberta joined the rest of the provinces, excepting Quebec and Prince Edward Island, in bilateral apprenticeship agreements with the federal government in 1945 based on the concept of equal cost sharing to cover "among other items, salaries of instructors, materials, supplies and training allowances for apprentices in full time classes". (Department

of Labour, Ottawa, 1946, p. 76). Of the $10,000 allocated to Alberta, $3,123.90 was claimed for the program which had a registered apprentice population of 382 (Department of Labour, Ottawa, 1946, p. 78).

Under the leadership of the first Director of Apprenticeship, Mr. J. P. White, Alberta had a program which ranked second in size and funding only to Ontario, consistently over the period of time 1945 - 1965. Registration figures reported by the Director of Technical and Vocational Training in Ottawa indicate the enrolments increased from 1949 to 1959 while they hit a plateau from 1959 to 1965 (Department of Labour, Ottawa, 1949 - 1969).

Apprenticeship populations continue to grow with the 1976 figure for Canada (excluding Quebec) at 74,129, up 10.6% from the previous year (Department of Manpower and Immigration, 1976).

The apprenticeship system as an administrative entity has much in common with institutionally focussed educational systems in the following kinds of activities:

a) registration of clients
b) scheduling
c) development of measurement instruments
d) administering evaluation
e) keeping of records
f) reporting of results
g) certifying

However, there are some major differences between institutional and apprenticeship approaches to learning. The historical roots of apprenticeship are non-academic, and are oriented to practical skills with most of the learning occurring on the job. The learner to master ratio is much lower than in traditional institutional settings. Co-operative involvement of a diverse group of government and non-government organizations is also a rule. Labour organizations, management representatives, employer groups, advisory groups, training institutions (public and private), and departments of manpower, education, advanced education, and labour all have an interest and a stake in apprenticeship.

Apprenticeship organizations provide a service function to this wide spectrum of groups, while at the same time attempting to serve the individual needs of the apprentice. The administration of these systems has direct and an indirect impact on the livelihood and career status of a significant segment of the workforce, e.g. through the legislation of wage rates and apprentice to journeyman ratios (Alberta Gazette, 1977).

The Apprenticeship and Trades Certification Branch in Alberta can be viewed as an organization with administrative responsibilities somewhat like other educational organizations. But it would be an over simplification to take the educational administrative computing services of a school board for example, as a model for procedures in an apprenticeship program.

As Hentschke (1975) points out, not only is there a difference between educational administrations and other organized enterprises, there are differences among educational organizations themselves in "terms of size, type of student served, etc." He goes on to say that "factors like these can indicate in a general way whether a computer-based information system is likely to be implemented." (p. 445).

Objective of the Study

These differences contribute to complicating the normal educational administrative roles outlined above. The combination of these complications and the increasing apprenticeship populations has given rise to the use of data processing by some apprenticeship administrations. The purpose of this study is to document the experiences of these organizations in order to review the development process and current status of data processing systems presently operational in this area.

General Statement of the Problem

The pressure of continuing industrial development in Alberta in combination with the success of the "Blue is Rewarding" campaign that encouraged trade training has resulted in a substantial increase in the population of apprentices in Alberta. According to the annual report of the Apprenticeship and Trades Certification Branch of Alberta, the 1976 apprenticeship population in this province was 16,059 - up from the 1973 figure (Department of Advanced Education and Manpower, 1977). This is an increase of almost 65% in the space of three years.

This has produced a concomitant change in the administrative workload, placing the Apprenticeship Branch of Alberta under considerable strain. Staffing has not kept pace with the increase in the number of apprentices. Over the period of 1972 to 1977, apprentices increased 106% while the clerical establishment changed approximately 34% (Department of Advanced Education and Manpower, 1972 - 1976).

The Apprenticeship and Trades Certification Branch (ATCB) currently predicts a client population beyond 20,000 in the fiscal year 1978 - 79. When the historical increase is translated into specific task areas, the following activities have shown increases over the last five years:

1) school attendance, up 69%;
2) number of courses, up 58%;
3) out-of-province apprentices, up 70%;
4) journeyman certificates issued, up 48%;
5) number of exams administered, up 84%.

One possible way to deal with this problem of increased administrative volume is to use data processing technology; however, no public documentation exists detailing the experiences of similar organizations which have gone in this direction.

As has been pointed out by Lawrence (1969),

> Institutions need comparable data from other institutions of similar complexity and with similar missions as a basis for evaluating the efficiency and effectiveness of their own internal operations. (p. 109).

Specifically related to the use of EDP, Bukoski

and Korotkin (1967) claim: "If we are to fully realize the potential of computers in education, more effort must go into the dissemination of information about computers to administrators ..." (emphasis in the original, p. 22).

With respect to the use of data processing, the problem can be stated in the following general way:

1) What impact has data processing had on the managerial and clerical functions of apprenticeship programs across Canada?
2) What has the experience been in terms of costs, timings, and benefits, both expected and actual?
3) What are the development and operations experiences of organizations which have similar goals and who have used administrative computing?

Significance of Study

For large volumes of routine clerical activity, electronic data processing (EDP) may be a useful tool. Some administrative organizations could not operate effectively without computers, as is the case with airline reservation systems. On the other hand, some systems have incurred enormous expense building EDP systems which are either dysfunctional or unuseable.

Soden (1975) documents five rather spectacular examples of management information system (MIS) development failures. He reports that a customer information system developed for a utility company was abandoned after incurring a cost of $7 million. The original estimate for completing this

system was $2.5 million (Soden, 1975, p. 31).

There is evidence in the literature that some innovations in education cannot be implemented effectively without EDP support. Neuhauser (1975) claims that while there are frustrations and difficulties in the design and implementation of a "management information system", she is convinced that this is the approach to "provide adequate information to support vital decisions." (p. 137).

In addition to the basic question of whether EDP will be effective, Brady et al. (1975) offer this observation based on their study of administrative data processing:

> Institutions seldom address questions such as these:
>
> . how should administrative computing be integrated into the overall administrative structure of the institution?
> . what contributions should information systems make to such institutional functions as controlling, planning, and evaluation?
> . who should be responsible for developing information systems? What should be the time frame for development? (p. iii).

The answers to these questions, which are inherent in this study, will be of value to the Apprenticeship and Certification Branch of Alberta and others in guiding future developments. This research will provide a rational basis for deciding the direction, nature, and extent of a commitment to data processing.

Other important benefits that will accrue from such a study are:

1) it will be a resource material for organizations in the preliminary stages of addressing the same problem;

2) it will provide the target study group feedback with which to compare themselves;

3) it will provide an examination of how data and information are employed in such organizations.

This study will contribute to filling the gap identified by the Computing Activities in Secondary Education (CASE) study (Bukoski and Korotkin, 1976):

> many schools or school systems are still "reinventing the wheel" with the development of uniquely tailored software systems. Though it can be said that the learning experience of "reinventing the wheel" may be quite valuable for a school, nonetheless it is a costly adventure in terms of time, dollars, personnel. It is precisely for these reasons - cost, efficiency and effectiveness - that one would expect a sharing of resources, expertise, program libraries and information through an active clearing house would enhance the productive movement of educational computing. (p. 21).

Delimitation of the Study

The study was confined to provincial apprenticeship administrations which, at the time of the study, used EDP to support their information processes. It does not address specifically the question of whether the processes are legitimate insofar as promoting apprenticeship training, but focusses on the impact of computer technology on those processes.

Limitations

The results and discussion of this study are limited by the degree of openness that the individuals and organizations studied could tolerate. A complete assessment of the above

issues was limited by the practical realities of time on the part of both the research team and the target organization, as well as the usual financial and personnel restrictions.

Summary

Apprenticeship organizations are administrative groups which are under pressure to continue to provide traditional levels of service in the face of increasing pressure. In part, since clerical support has not kept pace, the ATCB has elected to investigate new methods and technologies to deliver their service.

EDP is currently being used in similar organizations in Canada; hence, this research was conducted to provide the ATCB, and similar groups, a framework of information within which to consider future possibilities for their own organization.

CHAPTER 2

SURVEY OF THE LITERATURE

Apprenticeship as an Administrative Entity

Implicit in this research is the assumption that apprenticeship organizations can and should be viewed as identifiable administrative entities. A survey of the literature to date indicates that very little attention has been paid to the administrative aspects of this form of training. Instead, most of the effort to date has been directed to the areas of curricula development, drop-outs, and community expectations for apprenticeship graduates.

T. W. Broad (1975) touches on the issue, but emphasizes the direction and nature of apprenticeship experiences rather than the way in which resources are to be deployed in achieving specific system goals.

Discussions of the role of apprenticeship administrations are conspicuous by their absence in some studies. Beckman (1975) analyzed organizations of post-secondary education co-ordination across Canada, where post-secondary is defined as "all education beyond high school" (p. 6), and mentioned neither the Apprenticeship Branch nor the Apprenticeship Board.

Is it reasonable to expect that the ATCB will share many of the problems of institutionally oriented administrators? Miklos (1975) suggests the following activities are the responsibility of provincial educational administrators:

a) general educational policies

b) guidelines on the operation of schools, physical facilities

c) approval of programs, courses and resources

d) financing education

e) certification of teachers

f) supervision and consultant services to teachers.

There is substantial comparability between these tasks and those of the ATCB of Alberta. The Branch approves courses, sets general training policy, provides consultation to institutes and is the certification agency for tradesmen who may become trades instructors (Alberta Gazette, 1977, p. 15).

The Branch in Alberta also relates to an advisory group, the Apprenticeship Board in a way similar to universities and their Boards of Governors or school administrations and their school boards.

The Data and Information Issue of Administrative Computing

There is in the literature much use of the terms "data" and "information", especially when dealing with the problems of short and long-range planning and decision-making. That there is a substantive difference between these two concepts is generally agreed; however, there is some debate about what in fact this difference is.

Most authors imply a distinction in the value of data versus information. The added value inherent in information is transformational for Dorn (1971). This transformation occurs by some process such as "mechanical, electronic,

mathematical, or human." (p. 13).

Webster (1966) defines data as "things known or assumed; facts or figures from which conclusions can be inferred". What constitutes a "fact" remains a problem, as is demonstrated by McCorkle's (1977) definition of "fact": a fact is anything that people have agreed to stop arguing about. Webster's definition of "information" is "data of value in decision making". The implication in these definitions is that if man cannot infer a conclusion from a perception or phenomena, then it is not data. Further, the similarity and relationship between drawing conclusions and making decisions is such that these two definitions come close to being a tautology.

IBM (1969) defines "data" as "a representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation or processing by humans or automatic means." (p. 15). "Information" is defined as "the meaning that a human assigns to data by means of the known conventions used in its representation".

The idea of convention is expanded in the publication Introduction to Data Management (IBM 1970). The term "context" is used as being equivalent in meaning to "convention". Thus, information consists of three parts:

1) context
2) data and
3) data representation.

Data representation is the analog storage of symbols "to

which meaning is, or might be assigned." (IBM, 1969, p 15).

IBM (1970) gives an example of data about a person: Jones, John (p. 13). This piece of data might well be true, but before it is placed into context, any meaning inferred from it would be conjectural. This data might be the name of a person under discussion or the name of his or her next of kin. The accuracy of the information perceived from the data would also depend on whether the context placed the surname first or last.

The construct would therefore suggest that "placing into context" constitutes the process whereby data becomes information. Other potential elements of this process have been suggested by Eilon (1968):

> Information consists of data which have been measured or appraised as good or bad and by how much relative to a standard believed compatible with the objectives and goals of a business enterprise. Data are regarded as the raw materials from which information is produced (pp. 146-47).

Again, information is described as more valuable than data.

Complete agreement on these definitions does not exist as is evidenced by Andrew (1970) who says that information is the basic input into the computer (p. 99). Immegart (1973) also is in conflict with the above context-information concept with the statement "Information - in the form of data or hard facts - is most important to the educational administration." (p. 136).

Occasionally, the term "knowledge" is used in the

discussions of the use of EDP. Schmidtlein (1977) uses it in a context which asserts that knowledge used in making decisions often is not related to "modern systems of data collection and analysis ..." (p. 37). The implication of this statement is that knowledge is not necessarily related to EDP generated information in the narrow definition above.

There is some lack of distinction between the terms "information" and "knowledge" among some writers. Andrew (1970) says that knowledge of the fact that decision making is required is in itself information. Knezevich (1969) claims that "if knowledge is power, then relevant, well organized, and easily retrievable information is a source of super power." (p. 44).

Rarely, in the literature of EDP and administration, is the term "wisdom" used. Hartley (1969) says that while technology has advanced by a quantum jump, there has not been a comparable shift in human wisdom (p. 516).

Information and Decision Making

There is also some debate among authors on the importance of information in the decision making process. Summers (1974) claims that, whatever the approaches to identify and solve educational problems, "the effective location, organization, transfer and analysis of information is critical." (p. 11). Hentschke (1975) states that "systematically developed information is necessary for managerial decision making." (p. 16).

Mellor (1977) asserts that computer-based information

systems can extend "the bounds of rational decision making." (p. 29). The ready accessibility of such information, according to Banghart (1969), "should be a tremendous asset to the administrator pressed with constant decisions ..." (p. 107).

On the other hand, Cormier (1969) in his study of the information used by superintendents found results which tended to conflict with experts in "information management systems". He suggests that "it may be premature to conclude that executives should seek to obtain the help of computers in decision making." (p. 126).

Schmidtlein (1977) suggests that "most of the information used to make decision does not come from formal information systems" (p. 36). This, in combination with the observation of Cohen, March, and Olsen (1972) that decision situations arise in an unpredictable way, supports the finding of Cormier.

The narrower issue of decision making under crisis has been addressed by Smart and Vertinsky (1977). Their research deals in part with information overload, information processing abilities, the quality of information, and how these are related to decision making under increasing pressure. "Overload of information and the need to respond quickly force decision makers to use fewer channels, hence further reducing their alternate information sources." (p. 643).

The contribution of EDP information systems to decision making is assessed by Adams (1977). "Taken overall there is an indication that, while individual successes have been

recorded, the support of decision-making activities by these models has been equivocal at best." (p. 80). Sandin (1977) offers the supporting opinion that the costs have not been matched by corresponding benefits in decision-making (p. 27).

The reasons which are offered to explain this lack of success can be placed into two general categories, practical and theoretical. On the practical side, McCorkle (1977) identifies the problem that managers have "tended too often to let the data define our management options and how we should proceed with them." (p. 6). Another limitation to the usefulness of information system output in the decision-making process is that, according to Sandin (1977), it often is used to support independent intuitive judgements after-the-fact (p. 23).

On the theoretical side, Batchetti (1977) says that there is very little known systematically about how decisions are made in educational institutions. He goes further in saying that even less is known about how they ought to be made (p. 4). This is supported by Sheehan (1977). Most administrative users according to Sandin (1977) have "only the vaguest and most generalized idea of what kinds of information they need." (p. 23-4).

Quality of Information versus Quantity

Sandin (1977) is among many who raise the question of quality and quantity in information systems. Immegart (1970) in his discussion of administrative support systems states "too much irrelevant information is a luxury the

administrator often enjoys" (p. 136, emphasis in the original). It is worth noting that this description is applied generally, and is not aimed at EDP systems particularly. The implication of this observation is that information has a qualitative aspect known as "relevance".

Franks (1972) suggests that "The problem of relevance is the problem of the shopper for the information resource: where does he go for the information he needs, how does he recognize it, how does he know when he has sufficient?" (p. 8).

Other qualitative aspects noted by Cormier (1969) are accessibility, source, source reliability (p. 18-9).

The qualitative aspect of data and information is a complex issue for some authors. Stamper (1975) argues that the following are involved as characteristics to consider: accuracy, ambiguity, bias, credibility, distortion, entropy, noise, objectivity, logical information content, meaning, relevance, timeliness, etc. (p. 13).

The quantitative element of information appears to be an important issue as well, but there is some question whether more is better. McCorkle, Jr. (1977) suggest that "staff want more and more information because they hope it will tell them what policy position to take." (p. 8). Hartley's (1969) criticism is that in the face of increasing information "we cannot estimate the value and relevance of data" (p. 516). In his summary of a series of articles raising similar concerns, Adams (1977) recommends that the benefits

of more information as a result of EDP technology not be overestimated (p. 85). In fact, Adams (1977) goes on to point out that "Frequently additional information makes the decision harder rather than easier. In some senses, ignorance is bliss." (p. 86).

EDP Impact on Managerial Performance

In a paper on college administration, Clarke et al. (1973) wrote that the quality of decisions is directly related to the "quantity of relevant information" and the "quality of the analysis and synthesis of this information." (p. 13). They go on to argue the need for an "information management system" to support managers.

The reported utility of existing EDP systems for managers has been mixed. Schmitt (1976) reports the successful application of computing resources on an educational management problem, in this case one of staff accounting. Neuhauser (1975) says that EDP support significantly facilitates the management of a competency based teacher education program.

Hentschke (1975) observes that information technology affects the behavior of managers, but that "there is little consensus about the precise nature of the change, especially as regards education organizations." (p. 446).

In McCorkle's (1977) opinion, educational managers have used information poorly in the past, suggesting that the cause of this problem is found in the design of systems which primarily have been oriented to transactional data.

Adams (1977) states that part of the problem of ineffective information usage among managers is the "relatively low level of expertise that top administrators have regarding the analytical techniques used in higher education." (p. 82). This thought is echoed by Banghart (1969) who says: "there is not yet widespread use of quantitative techniques to administrative problems." (p. 64).

Another concern of managers about EDP generated information/data is identified by Schmidtlein (1977). "Policy makers sense the problems of data accuracy, the loss of detail in aggregations, and are suspicious of those who furnish and use data." (p. 37).

Adams (1977) also notes that the efforts in developing systems for managing educational information are the result of a "technology push rather than a management specified demand." (p. 80).

For Hentschke (1975) the apparent lack of obvious impact on managers of EDP information systems is due to the fact that management capability to use the information available depends "largely on a variety of intangibles concerning the quality of management and very little on the presence of a computer-based information system." (p. 443).

Mosman (1973) observes a different kind of effect. "As members of the staff begin to have frequent contact with the computing system and its support personnel, their thinking may subtly change." (p. 126). The direction of this change is one of increased structure in their performing

jobs, making decisions, and organizing personnel.

Organizational Level and EDP

Etnyre (1970) quotes Campbell as stating:

> Much of the foolishness which has been written and spoken about "management information systems" reflects confusion as to whether the system in question is to serve top management, executive staff, middle management, or first line managers. (p. 12).

Knezevich (1969) notes how information flows from the routine record-keeping functions required for operation, through the stage of providing supervisory information for operational control, to the point where it becomes information valuable for planning, policy, and evaluation. (p. 51).

Mellor (1977) suggests a similar typology in his discussion of management decision hierarchies. He uses the expressions strategic planning, management control and operational control and argues that each of these areas require differing information support. Hentschke (1975) uses exactly the same construct, and while he comes to the same conclusion, he notes that top administrators have a need for exception-type information as opposed to routine details. (p. 434-440).

McCorkle points out that in complex organizations such as educational ones, information serves decision makers in different ways, "depending on who the managers are and where they sit in the organization." (p. 2). Hentschke (1975) states that as a result of the differential way in which information is used, one would expect EDP systems to be most likely at the operational level. (p. 439).

Supporting this idea is Mosman's (1973) observation that the senior administrators often are not affected by "the advent of office automation" because they operate in an environment that is "rich in nonquantitative values." (p. 127).

Schmidtlein (1977) states "Information systems are usually based on assumptions about the degree of involvement an official can or should have in the policies and operations of lower levels." (p. 32). His analysis proceeds to explore some of the problems of who should get what information.

Systems Development Approaches

The literature of EDP systems development demonstrates much controversy over the question of whether such development should be done in the holistic way as opposed to employing a piece-by-piece strategy. According to Mossman (1973), educational organizations began using EDP in financial systems. Greenfield et al. (1970) reports that computing also has been used in "school timetabling, attendance reporting, report card preparation, and statistical reporting." (p. 12). Levien (1972) also has noted that in the past the most important applications to be programmed have concerned student record keeping as well as other personnel information. (p. 34-35).

In the early 1970's, it became popular to talk about the "total" or global "MIS" (management information system). Knezevich (1969) forecasted the potential effect of these

"on-line" complex data base systems. He envisioned senior administrators being able to make sophisticated enquiries for instant response on a wide variety of issues. (p. 56-57). Banghart (1973) refers to the use of a computer supported "total information system that would allow continuous monitoring of various activities in the system". He offers the opinion that this approach "should be a tremendous asset to the administrator pressed with constant decisions both of an immediate and a long range nature." (p. 107).

Mellor (1977) documents the success of one major integrated system, the well known Oregon Total Information System, which was funded by the American federal government. The dollar support in its first two operational years was over 1.38 million dollars. (p. 95). This facility provides an interactive query capability over a number of administrative files.

There is evidence in the recent literature that this approach has its problems as well. In the business sector, the problem had been discussed as early as 1971, by Demarco. In criticizing the total systems approaches he points out that the technology is not lacking; instead "the continual failures of the past twelve years are good empirical evidence that something was wrong with the concept." (p. 12).

Sandin (1977) observes that the design and implementation of information systems are time consuming activities

and suggests "Realistic recognition of the problem of timeliness would suggest a more piecemeal and less comprehensive strategy in system development." (p. 21).

Problem Areas in EDP Development

One of the most recent problem areas to be identified is that of the confounding political factors. Sterling (1976) notes "In the case of information systems, political ends are often achieved by management under the guise of instituting cost-saving efficiencies." (p. 9).

Robbins, Dorn, et al. (1975) suggest that controversy in the area of administrative computing are not technologically related but are the result of the perception that EDP will occasion a shift in the distribution of power. (p. 3). Keen and Czerson remark that, in the technical literature of computer specialists, "the analysis of political issues in organizations has not yet gone much beyond case studies and tentative theorizing." (p. 81). They point out that technical excellence alone is not enough to overcome political difficulties.

Schewe (1973) suggests that EDP development often fails to reach its full development because most of the attention is focussed on the technical aspects of the problem rather than on the system user. (p. 30). Sandin (1977) echoes this thought: "the problem stems from inadequate attention of the design stage to how information will be used and by whom it will be applied." (p. 24).

Ely (1973) concludes that there has been very little

distinction made among demand, need, and use of information, pointing out the "lack of reliable protocols to measure information needs." (p. 17). This issue can have serious impact on the definition of the specifications upon which rests the ultimate system construction.

There is also documentation of the difficulty in establishing cost benefit before a project begins and after it ends. As Fischoff (1977) reports "the decision reached in any analysis will depend on whose values are assigned to the various costs and benefits." (p. 179).

The activity of predicting the effect of EDP implementation in organizations is not an exact science. Becker points out that one of the most surprising results of research into this was designers and planners did not foresee many organizational changes, good or bad. "When computerization had a positive effect, it was sheer luck." (p. 13).

One of the factors that tended to interfere with EDP utilization in educational setting was the perceived non-humanness. Goodlad et al. (1977) note that education "is above all an activity conducted by and for humans" and that "automation of any part of education appears to be somehow degrading and suspiciously dehumanizing." (p. 29).

Sterling (1977) reports that "relatively few analyses have been devoted to systems features that may humanize organizations." (p. 2). The traditional systems analysis process, in fact, does not take the human system elements into account, according to Arnn and Strickland (1975).

(p. 13). They propose instead a development paradigm which focusses on the idea that it is people who make systems work.

Schmitt (1976) points out that some of the frustration in moving to use EDP was a result of the lack of orderliness in his manual system. (p. 45-46).

Resistance to Change

Resistance to change is a problem area that receives a great deal of attention in the literature. At the outset, Sterling (1977) notes that "designers of information systems are organizational designers as well, who cannot avoid changing organizations." (p. 2). Cohen et al. also suggest that it is not easy to change without unanticipated or negative consequences. (p. 247).

Hartley (1969) states that resistance to this change may be the result of a perception that "impersonal efficiency measures may be incompatible with the human subtleties of education." (p. 518).

Bennis (1973) notes that any significant change in an organization "involves a rearrangement of patterns of power, association, status, skills and values." (p. 105). Huse and Bowditch (1976) take issue with the idea that these changes will necessarily be resisted: "when people clearly recognize that the change is beneficial to them, they welcome it." (p. 428). They go on to say however, that it is "the real or imagined threat implicit in change" which is resisted. Computerized integrated management

information systems are specifically identified in this regard, because of the fear on the part of users that "they will lose control of their own data base and that the information will be used against them in a punitive fashion." (p. 428).

The "resistance to change" factor is significant enough to Hentschke (1975) that he recommends it be evaluated as an "organization constraint" in the system development cycle. Feeney and Sladek (1977) write on the subject of the systems analyst as a change agent, pointing out that analyses are prepared for the technical element of the occupation very carefully, but "rarely is much attention paid to training him to gain acceptance for organizational change." (p. 85). Whether EDP professionals actually contribute to resistance or merely deal with it from a framework of little knowledge is not well documented.

Bennis (1965) documents the problems of the theory and method of organizational change, underscoring the above concerns: "unfortunately, no viable theory of social change has been established. Indeed it is a curious fact about present theories that they are strangely silent on matters of directing and implementing change." (p. 769, emphasis in the original).

In an attempt to answer these questions, some authors recommend specific planning of the change element. Sterling states that "Organizational design should be taken on as an explicit design ..." (p. 2). Shelly and Cashman

(1975) suggest that participation by the employees and supervisors in planning the change will help to reduce resistance. (p. 47).

User Communities and Technical Experts: the Gap

There is much discussion in the literature on the communication gap between the administrative community and technical user. For example, the issue of the locus of control of administrative information and systems expertise has been explored by some authors.

Schmidtlein (1977) points out:

> The debate over the virtues of centralized versus decentralized governance structures has gone on since man first attempted cooperative activities. However, far too often the character of this fundamental dilemma is not recognized by those designing information systems. (p. 33).

Keen and Gerson (1977) state that software development (i.e. EDP systems) is not "merely a form of engineering"; while this may be true, Schmidtlein (1977) claims that too often "the design of information systems is treated primarily as a technical problem." (p. 29).

These observations carry implied criticism for information systems developers; there is also, of course, documentation of the other side of the coin. McCorkle (1977) notes that users have been "too quick to believe in the magical science of computerized information systems." (p. 6). He goes on to say that systems designers are at a serious disadvantage when user communities are unable to make "fundamental policy decisions about how to define a

student and how to define a program." (p. 7).

The usual strategy recommended by authors depends generally from which side the problem is approached. Authors such as Keen and Gerson (1977), writing in a technical journal, recommend increased user identification on the part of the systems analyst, while Greenfield et al. (1969) imply that administrators must become more aware of the technical aspects.

Sheehan (1977) bridges the gap by way of his "three-hat theory." (p. 93). He suggests that there is a need for a specific professional who is able to mediate between the decision maker and the technician. This analyst must be capable of wearing the hat of the technician or the hat of the manager and not perform the job of either.

This concept is consistent with Mosman's (1973) comment that it is not the job of the information consultant to administrate, but instead to act in a leadership role in providing access to new resources and skills available through information technology. (p. 136)

Summary

The literature on educational administration supports the concept of viewing apprenticeship organizations as administrative entities, despite the lack of specific attention in this area.

Administrative computing literature shows disagreement over the use of the terms "data", "information" and "knowledge". The term "wisdom" generally is not discussed.

There is also some dispute over the questions of:

a) How useful in the decision making process is information derived from formal sources of data (e.g. computer systems)?

b) What effect does increasing quantities of information have on the quality of information?

c) What impact do EDP systems have on managerial performance?

d) What effect does EDP have on differing levels in an organization?

e) Should administrative systems be developed holistically or piecemeal?

The literature also suggest a number of potential problem areas that must be addressed in EDP systems development:

a) confounding political factors;

b) difficulty in establishing the cost benefit factor either before or after project cycle;

c) inhumanness of the systems approach and product;

d) difficulty in reconciling disorderly manual systems with the orderliness of EDP systems;

e) resistance to change - identifying it and planning for it.

Finally, in an attempt to bridge the gap between systems designers and user groups, authors have recommended increasing the awareness of this technology among managers, improving the understanding of organizational behavior among analysts, or both. One other strategy

addressing the gap suggests the need for an information professional between these two groups.

CHAPTER 3

METHODOLOGY

The purpose of this chapter is to outline the methodology that was chosen. The question of research design is intimately related to the problem under study. The review of the literature revealed little study into the potential for administrative computing in apprenticeship organizations. EDP specifically oriented to educational administrations is well discussed, but as noted above, there is some conflict of opinion on a variety of points.

The goal of the study was to determine which side of the conflicting literature on information systems development would be supported by the experiences of apprenticeship administrations in the target population. The documentation of the successes and problems will act as the basis for deciding the direction, nature, and extent of a commitment to data processing in the ATCB of Alberta.

The method of study can be broken down into five major activities:

1) pre-study survey;
2) collection of background information;
3) preparation of the measurement tools;
4) execution of study and;
5) analysis of results.

Pre-study Survey

In order to determine which apprenticeship organizations in Canada use EDP, a pre-study survey was conducted.

British Columbia, Ontario and Quebec, at the time of the study, used this technology to support record-keeping in their programs.

As a result, this study was intended to be exploratory and descriptive. Since three organizations of varying degrees of similarity to the Apprenticeship and Trades Certification Branch of Alberta were the target study groups, a comparative case study approach has been used. This technique, which is widely practiced in business administration studies, has also been used effectively in educational research (see Nissen, 1969; Cormier, 1970).

The target groups were asked if they would participate in a study of this area and each agreed.

Collection of Background Information

Due to the different approaches to apprenticeship in the various provinces, background orientation was necessary to maximize the study time in each locale. Documentation of the target study groups, such as legislation, public relations literature, regulations, and other sources of shared information were collected and reviewed.

Preparation of the Measurement Tools

As the survey of related literature indicates, there is evidence that there is different impact of EDP on different organizational levels (Hentschke, 1975, p. 436-439; Robbins, Dorn, et al., 1975, p. 6-7). The literature also states that the relationship between the user community and the technical experts is an important factor as well

(Schewe, 1973, p. 30; Schmidtlein, 1977, p. 33).

With these issues in mind, a team of researchers with expertise in separate areas was selected. Details of the study personnel are found in Appendix B. The team was comprised of three core members:

1) software systems analyst to review technical personnel involvement;
2) an economist systems analyst to interview clerical personnel and their supervisors, and to review workflow and;
3) a team leader to co-ordinate activities and interview senior managers.

A representative from ATCB accompanied the study team to act as a liaison between branches and as a resource person for program delivery information. In each of the three cities (Vancouver, Toronto, and Montreal), a different individual from the Alberta Branch participated.

For each of the sub-areas of study a list of questions was drawn up and circulated to all team participants. The appropriateness, validity, reliability and completeness of the questions was discussed and a final set of questions was selected (Appendix A).

The contact person in each organization was called to co-ordinate interview schedules, and a follow-up letter confirming dates, study team structure, and general research intents was mailed by the team leader.

The interview team, including ATCB representatives,

was brought together for a briefing on background information on the target groups in order to ensure a relatively common understanding of organizational similarities and differences. Each of the core members was provided with enough copies of his portion of the structured questions to conduct as many interviews as required.

Team members were also cautioned about consistency in questioning and the problem of projecting bias was discussed.

Execution of the Study

The study was conducted over a three week period in the spring of 1977. Each case study began with the research team meeting a senior management representative who gave an organizational overview. The functional specialists then proceeded to their particular areas where the structured interviews were conducted.

Following each day of interviewing, the team met to review their findings for consistency, and to discuss areas of potential special effort or follow up on the next day.

A final major debriefing of each team member was conducted by the project leader and telephone contacts were made to investigate additional concerns. When all of the data was assembled, the senior management of each Branch was sent a letter of thanks.

Analysis

The information collected by the above steps then was analyzed by each of the core researchers and a report synthesizing the results was submitted to the project leader

with all of the source data collection questionnaires. The reports and data were reviewed and the following discussion and conclusions were generated.

Summary

To maximize the limited time available to interrupt the work of the target administration and to benefit from directed and specialized attention, a study team was brought together. With structured questionnaires, members of the team conducted interviews over a range of personnel from clerical workers to directors of program delivery.

Results were aggregated by the three areas of study:

1) management oriented questions;
2) operations oriented questions and;
3) technically oriented questions.

Raw data and specialist reports were analyzed.

CHAPTER 4

RESULTS

General Background

The results of interview process varied from interviewee to interviewee; individuals demonstrated behavior varying from extreme interest to simple refusal to answer some questions to general disinterest. However, by and large, the co-operation over the interview population was excellent.

Quebec

The status of apprenticeship in Quebec is and has been sufficiently different from the rest of Canada that it must be dealt with separately. In terms of provincially administered trades, the Province of Quebec had designated 23 trades, all of which had compulsory certification as a condition of journeyman employment. All of these trades were construction oriented, administered under the Construction Industry Labour Relation Act, and Manpower Vocational Training and Qualification Act.

The apprenticeship system is the primary responsibility of le Directeur de la Qualification Professionnelle under the Labour and Manpower portfolio. The office of Quebec Construction also has a responsibility in the record keeping in this area. Data processing has been used by this group for over seven years.

The Quebec approach tied apprenticeship and regional manpower planning together very closely by controlling entry into the program through the Quebec Manpower Centres.

Registering of contracts, controlling of wage rates, recording of hours of work experience, journeyman testing and certification constituted the primary administrative requirements of this organization.

At the present time there is no control by the Directeur de la Qualification Professionnelle over curriculum in technical institutes and no requirement on the part of an apprentice to attend a training course. As a result, this organization does not have to schedule apprentices for training or assess and record their technical progress from year to year, except to give credit for hours of experience. This obviates a major administrative problem with which other apprenticeship branches must deal.

Ontario

The Apprenticeship system in Ontario is under the Industrial Training Branch of the Ministry of Colleges and Universities. This Branch registers, schedules, records institutional results, examines for journeyman competence and certifies competence in 35 trades. The trades training population in this province was in the order of 28,000 for 1977 and data processing has been used here since 1970.

British Columbia

The apprenticeship system in B.C. is under the Apprenticeship and Industrial Training Branch of the Department of Labour with administrative responsibilities much the same as Ontario and Alberta. The trades training population of B.C. is about 16,000 and this organization was in

the process of implementing EDP. A complicating factor, in this case, was the re-organization/decentralization of this organization concurrent with the move to data processing.

Summary

The political location of each of these organizations is different: Department of Labour, Ministry of Universities and Colleges, and Department of Manpower and Labour. In terms of administrative functions, B.C. and Ontario are much the same as Alberta, while the Quebec approach is different.

In terms of size of clientele served, the Quebec and Ontario figures are higher than B.C. Quebec and Ontario have had a long term exposure to data processing technology, while B.C. is just beginning.

As a result of these differing approaches and degree of experience, comparisons are somewhat complicated. On the other hand, the study team had a wider scope of strategies to explore. For the purpose of the following discussion, the terms "operating" and "developing" will be used to distinguish functional systems from the one currently under development in B.C.

Technical Issues

Overview

Two of the systems (i.e. Quebec and Ontario) which were explored have been operating for a considerable time; as a result, many of the personnel at all levels who were

involved in system development have since changed jobs. These two systems were very stable, traditional data processing systems. The third system, in B.C., was developing, and provided a more sophisticated technical solution to user needs.

Development

In the traditional systems life cycle (Semprevivo, 1976, p. 14) of feasibility study, detailed analysis, design, construction and implementation, all systems reported user involvement of varying degrees for the feasibility, detailed analysis, and implementation phases. Technical personnel (i.e. systems personnel) report that in their opinion the user had, and exercised, adequate opportunity to influence the proceedings.

All technical groups reported that the kinds of systems alternatives were restricted by the technology of time, government policy on systems development, or both. For the systems currently operating, no one could recall whether formal review of the process or product was done. Similarly, development costs and schedule targets are unknown and, as was observed by technical experts interviewed, are probably inappropriate to act as a guide for today's circumstances.

In the organization developing a system, the data processing budget is shared by a number of groups in the same department. Thus, it is impossible to accurately identify specific costs; estimates range between $250,000

to $500,000.

Development problems as reported by technical people in each province varied. Lack of computing systems experience on the part of the analyst, inexperience and ignorance about data processing on the part of the user, lack of overall organizational commitment, difficulty in running two systems simultaneously with the same size staff, and resistance to change on the part of user staff, were all cited as complicating difficulties.

Current Status

Operational costs (1976) were approximately $60,000.00 for Ontario and approximately $110,000 for Quebec. These costs included processing of tradesmen's certificates as well; there is no attempt made to identify proportional costs between tradesmen's administration and that of apprentices. It was interesting to note that the Quebec analyst estimated that 20% of their costs were re-runs due to technical failures on the part of hardware.

British Columbia estimated that their operational costs will be $100,000 per year.

System failures have not had major impact on the operational systems in Ontario and Quebec, with the exception of the noted cost consideration in Quebec. Both systems have had the opportunity to use recovery procedures and reported no major difficulties. Data security was not given special attention beyond the data centre standard in each location.

Both Ontario and Quebec planned major systems reviews in future with a view to using the "on-line" facility of new data processing technologies. However, Ontario had recently re-organized and decentralized their operation and was in the process of developing a manpower policy; Quebec's change of government and the imminent development of manpower policy will have important impact on their operation. As a result, both of these organizations were waiting until their respective situations stabilized before pursuing significant system revisions.

Operations Issues

Development

Clerical personnel and their supervisors typically reported that the move to data processing was primarily due to workload levels increasing beyond the capacity of manual systems. The range of apprentice client populations that B.C. and Ontario serviced with manual procedures at the time of system initiation was 15,000 to 17,000. It should be noted that the Alberta population in 1976 was 16,059. Other reasons that were suggested by clerical staff for the development of EDP systems were: reduction in paper work and the size of files, and a possible interface "with Canada Manpower".

In the system development cycle, operations people reported that they were consulted early in the project, and generally not after that until implementation; or they were not consulted at all. Staff expressed a hesitancy to make

suggestions primarily because they were not sure as to their role in the process.

Training is identified by this group as a very important factor in both the implementation of a new system and in the turnover of staff. A computer concepts course, which is offered to the clerical personnel of one system, was very well received. Staff who returned from the course were "very keen on computers" despite the fact that participants were organizationally very heterogeneous (i.e. managers to clerical staff). Clerical staff identified a need for additional staff during the conversion of manual documents.

Clerical and supervisory personnel reported that the functional areas which used data processing most effectively were class scheduling, reporting of results, and registration/control of certification.

A computer generated report was viewed differently than other reports: in one instance a clerk was observed mimicing a computer report by using blank computer output paper in her typewriter and reproducing the unusual spacing that the programmer chose for the output, after changing the results.

The problem of data accuracy was mentioned as an occasional problem for field consultants. This seriously eroded the credibility of the computer system, administrative system, and personnel in the eyes of the public. Other contributing problem factors as noted by administrators were inadequate forms design, lack of training for high turnover

clerical staff, data entry by individuals with little vested interest in data accuracy, and lack of commitment or understanding on the part of those responsible for collecting it.

Current Status

The response of staff to the question of what operational goals were supported by data processing was interesting. Clerical staff and most clerical supervisors did not answer the question and demonstrated confusion about the intent. When alternative questions using words like "aim", "objective" and "purpose" were posed, the apparent confusion continued. The most direct answer to the question was by an analyst/researcher who stated that the organization had no operational goals.

Workload distribution was reported as stable, with major peaks handled in most cases by temporary help.

Sample input documents and outputs were obtained from each system. Clerical staff had criticisms of documents, but the degree of criticism varied from relatively minor complaints, such as the color and lines on one form being difficult to look at, to protests about the confusing format, data area physically too small, too many copies, and inappropriate information required. Minor problems were identified in the operating systems while major concerns were found in the developing system in B.C.

The reliability of systems currently in place was seen by operational staff as very satisfactory. As a result, no manual back up procedures exist that could immediately

take the place of the data processing systems.

According to staff, level of service in general to apprentices was not significantly improved. Generally, the perception of clerical people was that data processing helps to provide the same level of service to a growing number of people. There was no evidence anywhere of any formal measure of service level. In addition, there was no evidence as reported by clerical supervisors of staff reductions as a result of computerization.

In regard to impact on other organizations, operations personnel expressed the view that there is little of the data which would be of much use to anyone else. Quebec is an exception in this case as they have an important processing interface with the Office of Quebec Construction, another organization in the Department of Labour and Manpower.

Management Issues

Development

When describing the circumstances under which data processing was considered, managers identified increased workloads but went on to say this increase was due to policy decisions such as the Compulsory Certification of Qualification program in Ontario, or the desire for management and research information in B.C. The volume of population at the time of systems development in Ontario and B.C. were reported in the 16,000 to 20,000 range.

In all cases the system development was done by government employees usually within the same ministry as

the target organization at the time of development. None of the user departments had data processing expertise on staff.

Dissatisfaction was expressed by managers about their involvement in the systems development. User ignorance about data processing often led them to feel "at the mercy" of systems people who had little experience in the user area. All of the user organizations visited had a central office, and physically decentralized field service components. Typically, the central office was significantly more involved in system development than regional offices.

One organization reported borrowing external expertise to sit in on discussions about future developments. In this instance, data processing personnel dismissed one suggestion by the user as impossible; but the user computer expert pointed out that, while the suggestion may have been inconvenient for the computer group it was certainly not impossible. Had the user been on his own, the final outcome may not have been in his interest. This anecdote, if true, goes a long way to explaining why the expression "at the mercy of computer people" was so prevalent.

Project management in terms of budgets and also schedules was not remembered or documented in detail. However, managers of operating systems expressed the opinion that while both schedules and budgets were not met, this was secondary to the question of whether the system met the functional requirements.

The problems of the system development process were identified by the user group generally as follows:

a) User/analyst team were unable to foresee all the needs of organization and the complexity of system changes made adaptation to new problems difficult.

b) Differing groups in the organization had perspectives that were specific and narrow to their area, resulting in difficulty integrating elements cohesively during system implementation.

c) Staff were inadequately trained.

d) Data conversion is a costly, time consuming task that interferes with the ongoing job. When temporary help was employed, inexperience and a lack of commitment resulted in an unacceptable level of incorrect data.

e) Some forms were inappropriate in format, colour, complexity or apparent usefulness. None of the managers reported a reduction in the number of different kinds of forms; in the opinion of one individual the word "proliferation" more accurately describes the effect of data processing on paper.

f) Interpersonal relationships were cited as a problem. Misunderstandings and conflicts were attributed to: a lack of commitment; lack of data processing experience on the part of the user; lack of understanding about user operation on the part of the systems analyst; "negative thinking" or resistance

to change; or the "usual people problems".

In the two operational systems, no EDP system review after implementation could be rememberd.

Current Status

The question of the tangible and intangible benefits of data processing elicited one major common response; the ability to maintain levels of service with continuing expansion of client populations. There was some disagreement among the managers about whether turnaround time was in fact improved. One individual suggested that he now had a "more orderly" system.

The majority of managers said that data processing had no impact on their work patterns, or how they did things. One person felt that he was sure that his work has changed, but in very subtle ways that would be hard to isolate, due to confounding factors of policy and organization change. One of the two individuals to report significant impact suggested that the effectiveness of specially requested reports was a major factor.

Other individual comments and recommendations were as follows:

a) Focus of the system should primarily be on record keeping

b) The planning and preparation for the move to this technology is worthy of investing time and effort

c) There should be more interaction between field staff and "top brass" in the development process

d) Development of the system should be done from the bottom of the organization up

e) One current staff member should monitor the development process

f) There should be greater flexibility in the design specifications to allow for future functional requirements without major system overhaul

g) Training of staff is an important activity in order to reduce error rates, and give them some idea of how the pieces fit

h) System software maintenance should be done by user department personnel

i) Commitment of staff from the clerical levels to the highest level of management must be acquired.

Managers reported that routine operating statistics were the most useful output from their perspective. This was a result of the reported record keeping, administrative and control function of data processing. Research was either not done to any great extent or seen as not having much to do with the day-to-day operations.

The majority of interviewees perceived significant resistance to change but were in disagreement about the source of this resistance. The most common suggestion was that the resistance was due to organizational and individual inertia. Other suggestions were: lack of communication due to technical language of data processing personnel, lack of guidance and leadership, and failure to get commitment.

Future Developments

Both operating systems planned major reviews in the future with a view to extending current capabilities. Future development will await the consolidation of actual or potential changes resulting from policy and/or organizational adjustments.

When managers were asked for their recommendations, one suggestion was common: in-house data processing expertise is desirable. This idea is important enough that one organization is currently recruiting and another group has seconded a field professional with data processing exposure to act in an advisory capacity for central office.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

In order to place the results and subsequent discussion into an accurate perspective, a review of the methodological problems of the study is in order.

One of the first difficulties of this study was in the execution of the structured interviews. The respondents' approach to the questions was varied and, in the interview setting, each had the opportunity to query the researcher about the intent of the question. The interviewers had to be careful not to bias the answer.

Many of the interviewees declined to answer some of the questions and a number of reasons were offered as explanations. While some reasons were obviously reasonable, such as not having the information requested, it was apparent that some questions were avoided because of discomfort and anxiety on the part of the interviewee. This was evident especially in places where there was continuing organizational conflict over a related data processing issue. The question of what problems occurred during development and what were the causes, is a good example, especially where the evidence indicated that a colleague might be implicated.

Since the area under investigation is a complex one involving the relationship of people with technology, there are many potential confounding factors which cloud the picture. Quantification of these issues, particularly

where they inter-relate, is very difficult since the tools to measure the degree of organizational conflict, degree of success, and even the cost-benefit ratio are either non-existent or of questionable benefit (Fischoff, 1977).

The answer to the question of actual cost of system development could not be provided by anyone. The number of dollars expended on a particular project is probably one of the simplest and most objective measures that can be made, at least in terms of external resources required. Managers noted that whether or not projects came in under budget and on schedule was far less a concern than whether the system was functionally appropriate. Given the kinds of conflicts described by them, it is easy to understand this approach.

Some caution is advised in making comparisons among the different apprenticeship organizations in Canada. As noted above, the program in Quebec is substantially different from any other program in Canada and these differences seriously influence the administrative requirements of the organization generally and of the data processing component specifically. On the other hand, there are some areas of difficulty and success that the Quebec organization shares with Ontario and B.C.

The Differential Effect on Organizational Levels

A review of the literature reveals writing on the subject of "management information systems", or MIS as it is commonly abbreviated. The benefits cited by much of this literature are related to better management through improved

decision-making. Better decisions will be based on better and more extensive information provided by a computerized MIS. A National Centre for Higher Education Management Systems (NCHEMS) survey in 1975 ranked the improvement of internal management as the most important reason for initiating MIS development (Gaither, 1977, p. 47).

This study identified a major difference in the effect that data processing systems development in the organizational levels of apprenticeship administrations. All of the systems reviewed had the greatest impact in terms of day to day work patterns on the clerical level, and secondarily on the supervisors of the clerical groups. Senior managers typically received computer generated reports that produce information they received when the administrative system was entirely manual. The major reported differences between manual and computer systems were: 1) reduced clerical workload in producing the information; 2) reduced time in production; 3) a perception of increased accuracy and; 4) potential for accomodating future growth.

Therefore, a more accurate description of the systems under study would be "clerical support system". Most of the clerical functions under these data processing systems changed substantially; clerical supervisors therefore concluded that EDP systems require a higher level of training on the part of staff. There is some question whether this conclusion is substantiated historically by EDP alone; each of these systems had increases in complexity due to policy

and legislative changes as well.

Given the greater degree of impact on daily work patterns at the clerical level, it is a conclusion of this study that clerical people should be involved if possible, and informed at least, about the progress of systems development.

Development Problems

All organizations at all levels noted that the move to EDP was a major event, but there was a fundamental disagreement between technical representatives and the user community about user involvement in the change. The combination of reported user ignorance about the technology and system analyst ignorance about the user goes some distance in explaining the resistance to change demonstrated by these organizations.

There was no specific planning undertaken to deal with the human aspects of this change. It is only in the last two years much attention has been paid in the literature on the computer systems analyst as a catalyst or agent of change (Feeney and Sladek, 1977) although one 16th century author has expressed a related thought:

> It must be considered that there is nothing more difficult to carry out, nor more doubtful of success, nor more dangerous to handle, than to initiate a new order of things. For the reformer has enemies in all those who profit by the old order, and only lukewarm defenders in all those who would profit by the new order ... (Machiavelli, 1513; p. 21, 1950 edition).

In order to reduce the collective anxiety of clerical, supervisory, and managerial personnel, it is recommended

that the move to use EDP begin with a small non-threatening project. It is clear that this technology has serious impact; a modest effort that has high definition will have a higher chance of success, and a lower impact if it fails. The literature amply demonstrates that more and more organizations will be using EDP and that the trend in the use of administrative computing is toward increased sophistication (Robbins, et al. 1975, p. 6-7). Like any learning process, progress is easier when based on a foundation of positive experience.

The shift toward increased technology is serious and difficult enough that it should be done, if at all possible, at times of organizational stability. Two of the organizations recognized this and were deferring further EDP development until policy and organization issue resolution. Given the kind of confusion and difficulty demonstrated when policy realignment, reorganization, and EDP system development were attempted concurrently, this is a highly recommended course of action.

The reported effect of EDP on staffing levels is such that there should not be any expectation on the part of users to reduce personnel during implementation of these systems. In fact, all of the organizations documented the reverse situation in the short run.

Users who were not informed about EDP found the question of what role to play in the development process difficult to answer. As Churchman (1968) notes, the problem with

the engineering approach that is common to technically oriented people is that they expect the user to say what he wants, when the user has no experience upon which to base his expectations. This problem supports the above idea of easing the user into the technology with a modest first project to raise his level of awareness.

It is also suggested that the uninformed user should be exposed to the technology before proceeding to develop EDP supported systems, so that the user will be able to participate more intelligently in the process. As was reported, most staff who attended computing systems seminars returned to the jobs with a significantly more positive view, despite some serious limitations in this course. (The differential effect of data processing systems development from one organizational level to another has been demonstrated both in the literature and in this study. Yet the mix of personnel in these courses was across the full range of manager to clerk.)

Another difficulty experienced by user groups was the inability to demonstrate financial cost benefit. While it might be tempting to attribute this to the fact that these organizations belong to the public sector, and therefore have a greater interest in effectiveness than in efficiency, this problem is more substantial than that. Fischoff (1977) goes into some detail about the problems inherent in the whole concept of "cost-benefit", and points out that the results of any specific analysis of cost-benefit "will

depend on whose values are assigned to the various costs and benefits ..." (p. 179).

What measure can be made of the benefit of a "more orderly" system, as reported by one manager? And does a greater degree of orderliness have its costs as well? The difficulties that such questions pose for the manager who is attempting to assess the situation in a timely way are enormous. On the other hand, there was no documentation available from any of the groups studied on the actual cost of development in terms of budget dollars expended. It would appear that the decisions made by the managers to proceed with system development were based on a more global appraisal.

Given the workload volumes of each of the branches at the time of EDP development, there is some evidence to suggest that there existed an approximate volume of clients beyond which diseconomies of scale occurred, given similar administrative requirements. While most of the EDP systems did not result in an improved level of service to the public, senior managers suggested that a minimum level of service would be impossible to maintain without information technology. This constituted the basic justification presented by most managers.

As in the case with the measure of costs, and schedules, there was no evidence to suggest that any attempt had been made to formally assess productivity except in the grossest sense. The confounding factors of employee turnover and

increased complexity made it impossible to determine the change in worker and system productivity that occurred as a result of computerization.

Operational Problems

Training

There is no evidence to suggest that EDP systems perform any better than any other system in dealing with confusion or ignorance about organizational objectives. The question of the place of administrative computing in achieving those objectives was not answered at all by clerical workers and their supervisors. This is probably not a problem that is unique to data processing systems and the clerical workers associated with them. It is suggested by the results of this study that this is evidence of a training problem. The question of whether sophisticated training of high turnover clerical staff is cost beneficial is especially problematic given the limited attention that has been paid to establishing performance measures for such staff. It is impossible to say, as a result of this study, that a specific and formal training period would result in higher worker productivity, but the question bears further study on the basis of outstanding goal and cost effectiveness concerns.

Data Accuracy

One major problem that was identified by field service staff in using EDP system generated documents was that of data accuracy. This issue was particularly intense during

the file conversion process, where temporary help with no particular commitment to the organization were employed to convert data. The problem continues in systems which have been operational for many years as well.

This was especially frustrating to field personnel who must bear the brunt of public criticism in face to face confrontations, while having the least influence and least opportunity to change system data. They must of course take responsibility for errors that are generated from field originated documents. That errors will occur must be taken for granted. It is strongly recommended that apprenticeship organizations which plan to use EDP systems build in a capability for data verification by the person who has the greatest vested interest in its accuracy, the apprentice, the employer, or both. This data verification procedure should occur periodically (such as annually), with documentation on the current data stored on the individual/organization sent to the subject party, for correction and return. In order to improve the return rate of this turnaround document, it should be sent at the same time as other administrative documents that must be returned. A confirmation notice or school schedule would be an example of such a document.

This approach is consistent with the Stanley House criterion for humanizing electronic information system (Sterling, 1977). In addition to the obvious public relations benefit, this idea improves the quality of the

administrative data base, and the responsibility for accuracy is shared with the ultimate user of the system, the client. It should be noted that this capability is beyond that of traditional manual filing systems which preserve information away from the client in ways which discourage his involvement with the data as it is stored.

Managerial Performance

The survey of the literature suggests some conflict on the subject of the effect that information generally and EDP generated information specifically has on decision making and managerial performance. On the basis of the observations of this study, EDP information has no significant impact on the work patterns of the vast majority of senior administrators, in apprenticeship organizations. This is surprising given the general use of the expression "management information systems" (MIS) when discussing administrative computing. In the case of the study groups, MIS is a misnomer which hides the fact that all of them are basically clerical support systems, which also could be referred to as "transactional" systems due to the fact they focus on individual, micro aspects and data/information needs of the organization.

Whether the discussion centres on "transactional" micro systems or "planning" macro systems, the literature details differences of opinion, on the efficacy of formal information systems in contributing to managerial decision making. What expectations can a manager have for EDP

systems? The managers interviewed reported either complete ignorance at the outset or expectations that were unrealistically optimistic.

Expectations and Epistemology

The problem of developing appropriate expectations for the system that an administrator might be building or using is closely related to the confusion over terminology that is demonstrated by the various ways that authors use the same words. The confusion of terminology and expectations are bound up in the epistemological considerations of systems design. Referring to Webster, "epistemology" is the "study or theory of the origin, nature, methods, and limits of knowledge". It is proposed that the following brief epistemological model helps to resolve the debate in a way which will more closely align reality and expectations.

As the model in Figure 1 indicates, there are four terms: 1) data; 2) information; 3) knowledge and 4) wisdom. The decision making of educational administrators seeks to move as far to the right of the model as possible; that is to say, it is to be hoped that decisions should be "informed" at least, preferably "knowledgeable" and ultimately "wise".

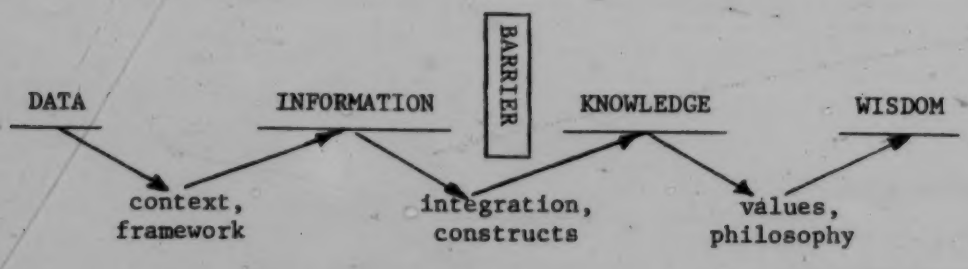

Figure 1.

The most elemental part of the model is data. For the purpose of the model the IBM (1969) definition as noted in the survey of the literature is used: "a representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or automatic means". "Information" is defined as "the meaning that a human assigns to data by means of the known conventions used in its representation." (p. 15).

This concept of convention is expanded in the publication, Introduction to Data Management (IBM, 1970). The term "context" is used interchangeably with the term "convention". An example of a piece of data is 140548. This data might be true, valid, and relevant, but without the context provides no meaning, and is therefore not information. However, when the context is provided with the convention, in this case a date of birth in the form day, month, and year, data becomes information. Thus the "placing into context" by providing a meaningful framework is the process whereby data is transformed into information.

Information is transformed into knowledge when information is integrated into more sophisticated constructs that relate a variety of pieces of information. Knowledge implies a level of cognition that goes well beyond a simple recitation of the facts. The distinction between "knowledge" and "wisdom" has its basis in values, or a philosophical point of view. A decision is judged wise when it is consistent with the principles of the judge's perspective.

The question remains: what can an educational administrator expect from an EDP system, in his quest to move from left to right in Figure 1? Beginning at the left, a computing system's capacity for the accumulation of data is effectively without limit. Currently, one foot of magnetic tape can store up to 75,000 characters of binary data, and the common reel of tape is 2,400 feet long. In addition to this, files are not limited to one reel of tape.

Manipulation of this data by sorting, classifying, and aggregating, can be done with great speed and great accuracy. Consequently, the potential production of information from data by the placing into contexts or frameworks is very substantial.

However, the transformation of information into knowledge requires human skills and comprehension beyond the current state of the computing art. Any EDP system which could achieve this would be an artificial intelligence. The barrier of comprehension and integration that separates knowledge from information is not one that a computer can transcend: therefore our expectations of the potential benefits of such a system must be tempered with the reality of how well we can employ the information resource as a foundation for extending our knowledge.

On the left of the barrier in Figure 1, the computer technician/technologist is found; on the right is the educational user community. How well has each side done in reaching across that barrier? Given the equivocal reports

in the literature on the effectiveness of EDP originated information on decision making, there is some work to be done in this area.

Transcending Information: the Three Hat Theory

In this study the use of existing computer files by managers is limited to the routine operating statistics which are very much like the reports generated by the previous manual system and the occasional special request. These special requests are relatively simple, such as lists of apprentices in a particular trade in a particular region or a list of potential award winning students.

The reasons for this situation vary from individual to individual, from situation to situation; generally, however managers have little knowledge of the specific data which are available and demonstrate very little understanding of what ways the data might be combined to support policy considerations.

One way of dealing with the barrier is referred to as the "three hat theory" (Sandin, 1977). The underlying concept is that both the educational administrator and the EDP professional have jobs that are sufficiently complex to require their full time attention. Thus the need for a "third hat". It is to be noted that what is meant by this expression is a third person who will act as a mediator between the two groups mentioned above, and not one person who will wear three hats.

As the technology of EDP advances, the whole area of

information/data management promises to get more complex. Data collection, processing, and dissemination is expanding with the advent of new methods: optical character recognition, voice recognition, mass storage systems, data base management systems, statistical and modelling packages, and microform advances are all indications that a new field of specialization may be on the horizon, that of the information manager/mediator. Hence the emergence of the "three hat theory".

Under the third hat will be the brain of a mediator who is able to identify the information resources that might be appropriate for whatever problem is under discussion. He will be able to contribute to the problem solving process of administrators by relating specific instructions to EDP personnel, among others, about what data is to be gathered and how it is to be processed into information.

As Churchman (1974) points out, the information scientist or manager is not just a librarian, since he will be required to pass judgement about the accuracy, appropriateness, cost, benefit, validity, and completeness of the information. He also will struggle with the problems of quality, quantity, ambiguity, bias, credibility, distortion, entropy, noise, objectivity, meaning, relevance and timeliness of the information resource.

The two organizations that were searching for an information consultant to help in system development and maintenance were essentially putting the "third hat" theory

into practice. Both of these groups had experienced undesirable effects from the gap between the user and the technical experts, and were in the processing of recruiting at the time of the study.

The gap between user and technician is not improved by the physical and organizational distance between the two parties. Physically, all computing personnel were located in separate buildings, and in two cases, the offices were located in different cities. As Cohen et al. have observed:

> the way in which the equipment and work space is physically laid out is a strong determinant of who is likely (and able) to talk with whom and when. It is difficult to form a relationship with someone who must stay at a work station on the other side of a seven-foot-high machine ... (p. 149).

With the data processing people, data entry people, and processing hardware located elsewhere, it is easy to see how a sense of remoteness evolves.

For a variety of historical and organizational reasons, all technical expertise responsible for either system development or maintenance and enhancement were employed and therefore primarily responsible to managers outside of the user area. Opportunities for conflicts of interests and commitment of time, energy, and interest exist under these circumstances. Examples of this conflict were evident in a number of individual instances. One person was assigned the role of evaluating and investigating the organization that he was ostensibly serving; the result of his effort was an extremely critical document which was unknown to

the user community. Another person had significant impact on the development of the EDP system by way of designing input forms and deciding what data was to be gathered. He responded to the question about what organizational goal were being served by EDP systems by stating that in his opinion the organization had no goals. These two incidents and the one where the technician attempted to claim that a particular process was impossible technically when it was only inconvenient, suggests that the gap between user and the computing systems community is not just epistemological. Thus the information mediator/consultant's role will also be defensive, as well as carrying the responsibility for information management, education, and innovation.

Data and Information Sharing: Inter-provincial

The study team investigated the prospect of establishing common coding structures between provinces in order to faciliatate inter-provincial data and information sharing. Technically speaking, data sharing between Ontario, Quebec and British Columbia is complicated by the fact that each province runs on a different machine. This factor is far less important, however, than the historical interprovincial differences of opinion about such things as trade definition and designation. Until these more basic differences are resolved, if they can or should be, it is unlikely that the sharing of data at the EDP level will be possible or productive.

Data and Information Sharing: Provincial

One other issue that emerged as a result of this study is the question of information sharing with external agencies. None of the apprenticeship groups studied reported any significant change in relationship with outside organizations, either public or private, with the above noted concern in the field with clients about data accuracy. However there was mention made in all cases of external users having an interest in the system data. This interest was just beginning to evolve at the time of the study, and raised some question of data confidentiality and processing costs.

Given the fact that it is expensive to collect, store, verify, correct, and process data, one organization is beginning to charge users on a cost recovery basis for the production of information which is outside the functional requirements of the apprenticeship branch. This promises to be a continuing issue. The question of inter-organizational sharing of EDP originated data will be an even more difficult problem for the future, as the technology improves the ability to do so.

Summary

On the basis of the collective experiences of apprenticeship administrations in the use of administrative computing, the following conclusions and recommendations have been made.

The introduction of electronic data processing technology

into traditional manual paper systems constituted a major change. Resistance to this change was reported, yet no formal effort was made to manage it.

The move to data processing is a significant enough event in the life of these organizations to warrant close attention by senior administrators. Therefore a period of program and organizational stability is recommended.

The EDP systems that are in place have a significantly different effects on the various level of the organizations using them. Clerical functions were radically changed, while management behavior and work patterns did not. "Clerical support systems" is a more accurate title for these systems than "management information systems".

There is very little evidence from the way that managers of these organizations used the information resource of EDP systems, that computerization improves management decision making or managerial performance.

The major benefit of EDP systems, as they are used in apprenticeship administrations, is not improved information or improved service to clients, but the ability to provide a minimum level of service to a continuously expanding clientele.

There is considerable difficulty demonstrated in establishing accurate costs and benefits that occur as a result of systems development, either before or after the project.

There is a great deal of evidence to suggest that the

gap between user communities and technical groups continues. The responsibility for this gap belongs to both groups, and to the fundamental misunderstanding over terminology and expectations. Given the increasing complexity of both the technical and the program sides it is unlikely that one side or the other will be able to bridge the gap and still maintain functional expertise.

An epistemological model has been presented as a means to resolving the conflict in terminology and for establishing a base for more realistic expectations about the potential and limitations of EDP in information systems. A discussion of the emerging "third hat" of organizations, the information manager/mediator, was the result of the barrier in the model. The model noted the technical opportunities and emphasized that human skills and comprehension are necessary to transcend the inherent limitations of data and information.

Therefore it is recommended that apprenticeship organizations recruit an information consultant to mediate the differences between user and technicians and to act as organizational educator and innovator, in the area of information use.

There is some confusion about whether it is computerization or policy change or both that accounts for the increased complexity of these organizations; in any event, there is an identified need for better methods for training staff. This conclusion is supported by evidence of

overwhelming ambiguity among clerical staff about the organizational objectives.

Managers should be exposed to analytical techniques for using information, including information that comes from EDP systems.

Computer system analysts must be trained for their role as agents of organizational change.

Given the human problems of data processing system development, this research supports the idea of element by element development as opposed to the holistic approach in some literature.

It is recommended that, as an adjunct to other methods of measuring and assessing the results of systems development, measures of productivity be developed.

It is recommended that the data stored in computerized files be subject, where possible, to the verification by those individuals or organizations concerned.

APPENDIX A

INTERVIEW QUESTIONS

MANAGEMENT ORIENTED QUESTIONS

Development

When did the organization begin to consider data processing and under what circumstances?

Who did the system development?

e.g. private consultant,
government service bureau,
user department personnel.

How much involvement did the user have in the system development cycle?

feasibility study -- was it done, by whom, alternatives identified, and documentation.
analysis
design
construction
implementation

Any major changes to the functional specifications along the way? If so what impact on the process did they have?

What comments would you make about the management and control of the project?

schedule -- was it met
budget -- what was it and was it met

What problems occurred during the system development?

What were the causes?
Recommendations?

Was there a review done following system implementation?

Documentation?
results?
conclusions?
recommendations?

What were the direct and indirect costs of the project?

Management Impact

What changes in management behavior occurred, i.e. work patterns?

What is data processing used for?

What information does the system provide for management?

What tangible and intangible benefits has data processing had in the organization?

How much good does the service do?
How good is the service?

What management goals are supported by the system?

Management Perceptions of Operational Impact

What do the operational people think of the system?

What do the technical people think of the system?

Was there significant resistance to change?

What current operational problems are you coping with?

What future plans do you have for the system?

Organizational Questions

What changes in the organization occurred as a result of data processing?

What is the relationship of the data processing group to your organization?

Has data processing had any effect on your relationship with other organizations?

What is your opinion about the possibility of attempting to organize uniform national coding structure for the sharing of apprenticeship data?

OPERATIONS ORIENTED QUESTIONS

Development

When did the organization begin to consider data processing and under what circumstances?

How much involvement did the operations staff have in the system development cycle?

feasibility study
analysis -- were the functional specifications documented and reviewed by you before design and construction?
construction
implementation -- what kind of system testing was done before implementation? was it satisfactory?
was it complete?
what kind of training was provided? how? by whom? how effective?

Current Status

What operational goals are supported by data processing?

Are the user manuals and procedures easy to understand and are they easy to use? Recommendations.

What is the distribution of work like among the staff and over time?

What documents are used: type, volume, retention, storage, security, appropriateness? Recommendations.

What audit controls do you have in place?

With respect to system inputs, processes and outputs:

how difficult are they to effect?
what are the procedures for this?
costs and time required?

How reliable is the system?

What procedures do you have in the event of system

failure?

What does management think of the system?

Service Aspects

Has data processing changed the level of service to apprentices?

Has this system had any impact on your relationship with other organizations in government? e.g. providing information services.

Impact on non-government organizations such as employers, union groups etc.

TECHNICALLY ORIENTED QUESTIONS

Development

What was your overall relationship with the user group during the development cycle? How responsive were they to the development?

What system solution alternatives were considered?

What problems did you have during development?

Were there changes to the functional specifications and if so how often and how significant? How were they dealt with?

Was there a formal review done of the system development process and product? Documentation?

What were the development costs?

Was the budget met?

Was the target schedule met?

Was the project control and management effective?

How was data conversion achieved?

Current Status

What are your current operational costs?

What do the operations staff think of the system?

What does management think of the system?

Is it possible to get a copy of the data elements stored and the coding structures used?

How is data entry done? Batch vs online.

Which storage medium is used, and how much?

Which access methods?

What about software?

Proprietary - how much

- what kind
- problems
- benefits
- maintenance

In-house

- problems in development
- recommendations
- maintenance

Future plans

How is file maintenance done?

Recovery procedures - what are they and how effective?

- Have they ever been tested?
- Needed?

Data controls?

- security
- back up
- audit trails
- data validation
- output controls
- access to data

Problems? Recommendations?

APPENDIX B

LIST OF TEAM PERSONNEL

APPENDIX B

List of Personnel

Project Director - M. M. Marche B.A. (Economics), Professional Diploma in Education; five years experience in the areas of management research, data processing and systems analysis and one year as an instructor at NAIT in computing systems technology.

Economist/Systems Analyst - P. McFarlane B.Comm., Diploma in Computing Science; five years with the Planning Secretariat as a research economist and systems analyst.

Technical Support Consultant - R. Senda B.Sc. (Mathematics), currently finishing a M.Sc. in computing science (area of specialty - data base systems) three years experience in systems analysis and one year instructional experience at NAIT.

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